Yield behavior of Hiruzenbara Diatomaceous Earth

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1. Introduction

Yielding is an important feature of the stress-strain behavior in soil mechanics. In this study, a diatomaceous earth sampled at Hiruzenbara (Okayama Prefecture, Japan) is investigated. Hiruzenbara (Okayama, Japan) diatomaceous earth is a lacustrine sediment deposit during the late Pleistocene epoch. Index and physical properties are shown in Table 1. To study the yielding behavior of the material, a series of triaxial compression tests on intact block samples were performed. The specimens are consolidated at different OCR and then subjected to drained and undrained compressions. Stress-strain relationships are described. The yield curve obtained is compared with yield curves of previously investigated diatomaceous earth (Shigematsu, et al., 2002) and Osaka Pleistocene clays (Yashima, et al., 1997), in order to better assess the yielding characteristics.

2. Stress-strain relationship of Hiruzenbara diatomaceous earth

Consolidated undrained triaxial compression tests have been carried out on Hiruzenbara diatomaceous earth at different over-consolidation ratio. The stress-strain and pore pressure-strain relationships are sketched in Fig.1(a). It is found that the specimens exhibit a strain- hardening and strain-softening behavior. The stress drops continuously down to the residual stress after the stress reaches the peak value. From the effective stress path outlined in Fig.1(b), the diatomaceous earth shows a negative dilatancy in the normally consolidated region, but smaller negative dilatancy is observed in the over-consolidated region.

3. Yielding behavior

The yield locus delimits a zone in which soil behavior is mostly elastic from a zone in which it is mostly plastic or where there is failure. The yield points are determined as sketched in Fig.2. A series of isotropic consolidation test, consolidated-undrained and consolidated-drained tests at different rates have been performed that result in the yield locus of Hiruzenbara diatomaceous earth. The yield loci in Fig.3 are normalized with respect to the isotropic preconsolidation pressures, and then yield loci of diatomaceous earth (Hiruzenbara, Takasu) and Osaka Pleistocene clays (Kyuhoji, Tsurumi) are drawn. It is found that the shape of the yield locus for Hiruzenbara diatomaceous earth is not symmetric with respect to the mean effective stress axe. This reflects the anisotropic properties of that material. The yielding behavior of Hiruzenbara diatomaceous earth is found to be quite similar to the yielding properties of Takasu diatomaceous earth, but the Osaka Pleistocene clays exhibit much more anisotropy.

4. Conclusion

The Hiruzenbara diatomaceous earth exhibits a strain-hardening and strain-softening behavior with a negative dilatancy in the normally consolidated region and smaller negative dilatancy is observed in the lightly over-consolidated region. Yielding properties of Hiruzenbara diatomaceous earth is anisotropic. The shape of the yield locus is similar to the Takasu diatomaceous earth. Osaka Pleistocene clays are more anisotropic than the diatomaceous earths.

Keywords: yield, dilatancy, diatoms

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